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THE EFFECTS OF INSECT DEFOLIATION AND INTERPRETATION ON RECREATION VALUE

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Running Head: Insect Defoliation and Recreation Value

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ABSTRACT

This paper focuses on the effect of National Park Service (NPS) public interpretive programs (interpretation) on visitor perceptions of scenic beauty and their agreement with NPS policies in the context of an outbreak of pandora moth (Coloradia pandora Blake) on the North Rim of the Grand Canyon in Arizona. The pandora moth caterpillar is a native defoliator of ponderosa pine (Pinus ponderosa Dougl. ex Laws.). A visitor survey was conducted at the site of the defoliation during its peak in June and July, 1987. Interpretive brochures were provided by the NPS on alternate days during the course of the survey to enable interviews of both visitors who had and had not received the brochure. Respondents were asked to place photographs depicting different degrees of defoliation in forested settings in order from least to most attractive, and to indicate their willingness to pay to visit the area under the conditions depicted in the photos. They were also asked to describe how seven different factors, (e.g., canyon views, forest scenery, temperature, climate) affected their experience at the North Rim and to respond to a set of six policy statements regarding management of the park environment. Results show that the interpretation instrument did not affect the ability of the respondents to distinguish between levels of pandora moth defoliation, or the willingness to pay estimates associated with the depicted forest conditions, but it increased the number of correct responses regarding what caused the defoliation. Visitors who had read the interpretive brochure more often identified pandora moth (or "insects") as the cause of defoliation, and they were more accepting of NPS policies that allow such phenomena to follow their natural course.

INTRODUCTION

During the summer of 1987, an outbreak of pandora moth (Coloradia pandora Blake) occurred on the Walhalla Plateau on the North Rim of Grand Canyon National Park in Arizona. It was expected that the defoliation would occur from June through July, and that approximately 7000 acres would be affected to some degree with the possibility that large stands of trees would be more than 90 percent defoliated. The pandora moth has a two-year life cycle in which the larvae emerge from eggs in the fall, overwinter as larvae on ponderosa pines, (Pinus ponderosa Dougl. ex Laws.) and continue feeding on pine needles the following spring (Patterson, 1929; Keen, 1952; Carolin and Knopf, 1968; Miller, 1983). Larval feeding in May and June can cause extensive ponderosa pine defoliation. The larvae pupate in July and emerge as moths the next summer. Peak defoliation generally occurs every other year in late June and early July for a period of six to eight years, after which the population collapses naturally (Keen, 1952). Defoliated areas, including those of near total needle loss, recover by early August. Very little tree mortality occurs as a result of the defoliation (Patterson, 1929; Miller, 1983; Wagner and Mathiasen, 1985). This outbreak provided a unique opportunity for research. The National Park Service is mandated to provide for visitor enjoyment while also protecting the natural resources. These two sometimes conflicting goals have led to the development of interpretation, an attempt to communicate the goals of the

National Park Service to the visiting public through fostering an understanding of the processes of nature (Sharpe, 1982).

Because the National Park Service (NPS) is a public agency, it is affected by public opinion about the appropriateness of its' actions and operations. Interpretation is one method that the NPS has used to rationalize and garner support for management policies. Yet, although it has generally been accepted that interpretation is worthwhile, there is little empirical research on the effect on attitudes and perceptions. Taylor and Daniel (1984) found that public knowledge of fire effects and tolerance of low-intensity fires was increased by providing the public with educational brochures. At the same time, they found no evidence that perceptual judgments of scenic beauty or recreational acceptability of burned forest areas were affected by the increased knowledge or expressed tolerance. Cable et al. (1987) found that attitude scores of visitors that had received interpretation (brochures and cassette tape media) were more favorable from an agency standpoint than of the scores of visitors who had not received interpretation. Taylor and Mutch (1986) found that the public is more knowledgeable and more willing to accept new wilderness fire management practices than they were 10 years ago. Perceptions of scenic quality and recreational acceptability, however did not necessarily correlate with these knowledge changes. Young (1980) found that information levels were important in determining peoples'

opinions about wilderness, and that more information correlated with more acceptance of the wilderness concept.

The picture that emerges is that knowledge, expressed tolerance, and perhaps, expressed attitudes may be changed by an interpretation instrument. Perception and recreation preference, however, seem impervious to the same interpretation efforts.

An important NPS policy allows natural occurrences such as insect outbreaks to run their course without human interference or control. For example, no plans were made to control the pandora moth outbreak on the North Rim. Yet, it has been shown that insect damage in forested areas does detract from visitor's perceptions of the scenic beauty of the area (Buhyoff and Leuschner, 1978; Leuschner and Young, 1978; Buhyoff et al., 1979; Buhyoff et al., 1982).

The North Rim pandora moth outbreak occurred along the only road that leads to Cape Royal, a popular canyon overlook. This afforded a unique opportunity to investigate visitor reaction to the outbreak, and to determine the effects of typical NPS interpretation efforts. It was expected that while interpretation would affect visitor acceptance of park policies, perceptions of the scenic beauty of the area would not be affected by interpretation. Other hypotheses were that forest scenery is important to visitors to the North Rim, that willingness to pay to visit the area would change with levels of defoliation, and that defoliation was a factor affecting attractiveness of forest scenery.

The purpose of this paper is to report the results of research directed at the following question. What affect does insect defoliation of forest trees have on the value of the recreation experience of Grand Canyon visitors and can NPS interpretation mitigate the effect?

METHODS

An on-site survey was conducted during late June and early July of 1987 to determine how NPS interpretive efforts affected visitor perceptions of defoliated areas and the degree of visitor agreement with NPS policies regarding such natural occurrences within the park. Visitor willingness to pay for a visit with different degrees of defoliation on the North Rim was also assessed.

The survey was conducted for eight days, June 23-July 1, and then for another eight days, July 5-July 13. While a U. S. Forest Service Pest Management survey conducted in the winter of 1987 indicated very high insect populations, defoliation did not occur to the degree expected along the Cape Royal road. The most severe defoliation occurred near Walhalla Overlook. However, even at this point defoliation was not readily apparent to most visitors.

Defoliation Photographs

Permanent photo points were set up early in the summer of 1986 at tenth-mile intervals along a two and a half mile

stretch of road leading through a ponderosa pine forest. Photos were made of the undisturbed forest, with photos taken in four directions from each point. In like manner, a photo record then was kept of the progressing defoliation during the late spring and summer of 1987. All photographs were taken at the same time of day, with cloud cover avoided, in ponderosa pine stands of similar basal area. They were taken with a 35 mm camera on color film. Some of these photographs were used to create photo cards, each containing four photographs, that were shown to visitors for evaluation during the survey.

The photographs were chosen to represent different degrees of defoliation in the forest. Defoliation rating guide cards were created by successively defoliating a ponderosa pine branch in ten-percent increments and photographing it. These guides were subsequently used in the forest to help in the selection of the photographs used on the photo cards. Four photographs were selected from a set of photographs taken along the Cape Royal road the year before the defoliation occurred to create a photo card that had no pandora moth defoliation in it. Four photographs which were taken in the most heavily defoliated section of the forest were also placed on a photo card. These two cards were used as endpoints (Figure 1). Two other cards that were judged to show intermediate but successive amounts of defoliation were also created.

Photographs representing areas being judged for scenic beauty have been shown to provide ratings similar to those for

the actual forest scenery (Shafer and Richards, 1974; Daniel and Boster, 1976; Brush, 1979).

During the survey, respondents were handed the photo cards and read the following statement:

> "Now we are interested in how changes in forest conditions at the North Rim might affect your trip. This set of photographs was taken along the last few miles of the road out here to Cape Royal at different times over the past two years. Each set depicts different forest conditions that have occurred and we are interested in your judgement of the relative scenic beauty of the forest under each of the conditions represented.
>
> "Please look at the photos in each set and try to get an idea of what the forest would look like under the conditions shown - note that it is the forest that we want you to judge, not the quality or composition of the particular photographs that are presented. We would like for you to rank order the forest conditions represented in the photo sets based on your perception of the relative scenic beauty of each. You may wish to first determine which set you would judge to be the least attractive condition and place it on the left side of the table. Then decide which would be the most attractive condition and place it on the right. The remaining sets can then be placed in order between the two endpoints. Take your time, and rearrange the photo sets as many times as you wish. Please let me know when you have them in their final order."

Respondents were then asked to place a blank card on or between any of the ordered photo cards representing the scenic beauty position of the Walhalla plateau area. The positions of the four blank photo cards and the blank card were then recorded on the questionnaire. This procedure was intended to determine whether or not visitors noticed areas of defoliation as they drove through a forested area, and whether such areas were memorable to them.

Interpretive Brochure

The NPS prepared an interpretive brochure on the pandora moth which was handed out every other day along with other Park Service information at the North Rim entrance station. Other interpretation was also provided in the form of NPS talks. The handout informed the readers about the insect outbreak, detailed the pandora moth life-cycle, and explained that most of the defoliated trees would not die, but would recover by the end of the summer. Finally, the handout examined the NPS policy that allows a natural occurrence to run its course. The handout observed that "although defoliation may be unsightly to us for a short time, proof is all around us that areas undisturbed by humans retain their natural beauty."

Cause of Needle Loss

Respondents were handed the most defoliated photo set and read the following statement:

> "You may have noticed that some of the trees along the road looked like this. What do you think caused the loss of needles?"

Respondents were also asked whether or not they had received the NPS's interpretive leaflet, whether or not they had read it if they had received it, and whether or not they had heard about the pandora moth in an interpretive talk or through any other source. Data were separated depending on whether or not the respondent had read the brochure or received an

interpretive talk, or both, or had not had any form of interpretation. Simply hearing about the existence of the pandora moth was not considered to be interpretation.

Policy Assessment

Each respondent was handed a card on which was printed a scale of agreement, a statement about the NPS policy which allows a natural process to run its course, and six statements regarding that policy. Figure 2 is a representation of the card. All of the statements were read aloud as the respondent followed along, and the response to each statement was recorded on the survey form.

The Survey

The survey area was set up along a footpath leading from the parking lot to the canyon overlook. Three interviewers were stationed at the area. They approached visitors returning from the overlook at random and asked if they would be willing to participate in the survey or they accepted volunteer respondents. The interview took 15 to 20 minutes.

The survey instrument contained questions on scenic beauty, NPS policy, factors affecting visitor experience, willingness to pay to visit the area, and whether or not interpretation was received and read, as well as demographic questions and data recording environmental conditions. Two different versions of the questionnaire were used, one focussing on forest scenic

and one that included contingent valuation of forest scenery. Each version was administered alternately to one-half of the sample.

Seven hundred and thirty-three questionnaires were completed during the 18 days of the survey, with approximately 45 being completed each day between 9 am and 5 pm. Of these, eight were removed from consideration due to significant respondent language problems or other obvious problems that might have biased the results. Seven hundred and twenty-six questionnaires were included in the final data file.

RESULTS

Each of the three interviewers interviewed approximately one-third of the respondents. Nearly two-thirds of the respondents (63%, 454 respondents) were male. In the first section of the instrument the interviewer recorded present state of the weather, whether canyon views were clear, hazy, or foggy, sex of the respondent, the time and date of the interview, and the language facility of the respondent. The sky was partly cloudy most of the time, it was usually breezy, and the view of the canyon was about evenly split between being hazy and being clear. Language facility of the respondents was judged to be good in all but a very few cases. Most of the respondents were travelling on their own and not with an organized tour. The modal age of respondents was about 40 years and their modal income was about $50,000 per year. Travel and demographic

information on respondents is summarized in Table 1.

Visitor Experience Factors

Respondents were handed a card listing seven factors and indicating five response levels, from "subtracted a lot" to "added a lot" (Table 2). The interviewer read the factors aloud, and the respondent indicated whether the factor added to or subtracted from his visit. Thirty-nine percent (281) of all 726 respondents answered "not applicable" to the nature study and interpretation factor, indicating that they had not received any interpretation or participated in any nature study.

Very few people felt that any of the factors mentioned in the questionnaire detracted from their experience. As shown in Table 2, facilities received the highest negative response, with 14% of a total of 99 respondents saying facilities either subtracted or subtracted a lot from their experience. Nearly 91% (660 of 726) felt that canyon views added a lot to the experience and 96% (699 of 726) felt that forest scenery added to the experience to some degree, with 75% (543 of 726) saying that forest scenery added a lot.

Interpretation Effects

A chi-square statistic was calculated to test the independence of interpretation from the responses to each of the factors (Table 2). The results of the chi-square ($p=.05$) show that interpretation is not important except in the case of the

nature study and interpretation factor, where the response is linked to whether or not interpretation was received.

An analysis of variance was also used to determine whether or not interpretation affected the way in which the factors were scored. Since 246 visitors received interpretation, while 480 did not, the number of no-interpretation subjects was randomly reduced to equalize the size of the two groups. A Student-Neuman-Keuls test was performed to determine if forest scenery was important to respondents.

Interpretation did not significantly affect the scores, either as a main effect or in interaction with the visitor experience factors. However, there was a main effect in the experience factors and the Student-Newman-Keuls test showed that the mean scores for all of the factors were significantly different from each other at the .05 level. The factor receiving the highest, or most favorable, responses was canyon views, followed by forest scenery (Table 3).

Travel Expenditures

A total cost for the North Rim portion of the visitor's trip was determined with the help of questioning by the interviewer. The stated expenditures were restricted to those made within the park boundary and represent household values. Respondents' reported costs are summarized in Table 4. The average cost of food, beverages, and incidentals (including mule rides and souvenirs) was about $51.00, with 71% (510) paying

under $50.00. The average cost for lodging at the North Rim was nearly $40.00. More than a quarter of the respondents reported no costs for lodging, as they either stayed outside the park or were on a one-day trip.

After totalling the separate costs for the visit, each respondent was asked whether or not the total cost sounded correct. If the total cost did not sound correct, the respondent was asked to correct it and this new value was entered separately. The average total cost reported for the North Rim portion of the trip was $155.00 per household.

Willingness to Pay Estimates

Based on the reported total cost, the visitor was asked to estimate the "most s/he would be willing to pay for the visit rather than forego the North Rim experience". These willingness to pay estimates included the $155.00 reported actual costs.

The average amount that a respondent estimated he would pay for his present trip rather than forego the opportunity was $439.00. If a respondent gave a maximum willingness-to-pay figure that was equal to or lower than his actual present costs, he was asked to explain. Two percent of the respondents indicated that the trip was worth exactly their actual costs. One respondent indicated that the trip was not worth what he had spent due to the quality of the facilities.

Scenic Beauty Estimates

Respondents were shown a set of four cards each with four photographs on them. In general, respondents preferred the photo cards depicting less defoliation to those depicting more (Table 5). However, with the exception of the most defoliated photo card, there was considerable disagreement about the attractiveness of the photographed areas.

Ninety-six percent (689) of the respondents ranked the card with the most defoliation lowest in attractiveness, and 37 percent (269) ranked the card with no defoliation highest in attractiveness. Forty percent (290) placed the second least defoliated card in their "second most attractive" position, corresponding to its position in the defoliation order. Fifty three percent (385) ranked the second most defoliated card third, or "next to least attractive", corresponding to its position in the defoliation order. Overall, however, only 27% percent (197) of the respondents arranged the cards in order from least to most defoliated, and indicated that this was their preferred order (Table 5).

Twenty percent (148) of the respondents admitted that they could not remember Walhalla Overlook at all and could not respond to the question concerning where the attractiveness of the forest fell in relation to the photo cards. The remainder placed the blank card representing the Walhalla Overlook area, where the most defoliation occurred, and where the photographs on

the "most defoliated" card were taken, in a variety of positions with little consistency.

A chi-square analysis was performed to test the independence of the interpretation and ranking variables. There was no significant difference ($p=.05$) in the rankings of respondents who received interpretation and those who did not (Table 6).

Contingent Valuation of Forest Scenery

The respondents who received the contingent valuation version of the questionnaire were reminded of the maximum amount they had previously stated they would pay for their visit. They were then asked to estimate the amount they would pay for their visit if the forest resembled the conditions represented on each of the four photo cards.

For the respondents' least favorite card, the mean value given was $335.00. Nine percent (30) said they would not pay anything to visit the area if it looked liked that card. The mean for the second least favorite card was $391.00. Only two respondents said they would not pay to visit an area that resembled that card. The mean for the second most favorite card was $403.00. One respondent said he would not pay to visit an area that resembled that card. For the favorite card, the mean value was $419.00. No respondent said that they would not pay to visit the area if it appeared as in their most preferred photo set.

Although the reported means show a progression in value as

respondents consider successively more attractive forest conditions, an analysis of the difference between the respondents maximum willingness to pay for their existing trip and the amount they would pay to visit the area under the conditions depicted in the photo sets showed that most respondents (70%, 508) would pay the same amount to visit the area under all of the conditions. Of the remainder of the respondents who changed their maximum willingness to pay for their trip in response to the different photo cards an analysis of variance with Student-Newman-Keuls test showed a significant difference ($p=.05$) between the mean willingness to pay for the least attractive card and all other means. However, there is no significant difference between the other means.

Perceived Causes of Defoliation

When respondents were asked what caused the loss of needles in the most defoliated photo card, 21% (152 of 726) answered "insects in general" while 16% (117) specified the pandora moth. Another 17% (122) believed that the loss of needles was caused by fire, and 8% (58) answered "disease in general". Other popular responses included pollution, acid rain and drought. The remainder gave a variety of responses ranging from depletion of the ozone layer to damage by possums.

A chi-square analysis on the most popular responses to the question showed that interpretation had a significant ($p=.05$) influence on visitor responses to the question. Eighty-four

percent (207) of the respondents who received interpretation responded either "insects" or "pandora moths" (Table 7).

Policy Assessment

Table 8 shows the number of visitors responding each of five ways to each of the six policy questions represented in Figure 2, separated by whether or not the respondent received interpretation. A chi-square analysis of the relationship between interpretation and responses to policy questions showed significant ($p=.05$) interdependence with all but the question involving general long-term change. That is, interpretation affected the way people responded to each of the policy questions except one dealing with long term impacts.

Responses to the latter question are statistically independent of interpretation. This was supported by an analysis of variance showing that interpretation is an important factor in determining how the visitor responded to the policy questions. A Student-Newman-Keuls test showed that there are significant differences between the mean scores of all of the policy questions, with the question involving short-term change receiving the most positive score and the question about long-term change around the cabins and lodge receiving the least favorable score (Table 9). This result emphasizes the finding that respondents are prone to disagree with NPS policy when it concerns long term changes to the forest around the cabins and lodge, even after receiving interpretation.

DISCUSSION AND CONCLUSIONS

Interpretation can positively affect visitor attitudes about management policies and increase support for particular policies (Cable, et al., 1987). This is important to an agency like the National Park Service, which is mandated to provide for visitor enjoyment while also protecting natural resources, and which also relies on public support. Public recreation agencies would like to be able to mitigate the effects of natural occurrences such as insect outbreaks on recreation value while also increasing public understanding and support. Interpretation is one tool that is available to achieve these goals.

Interpretation has not been shown to have any effect on how visitors to the North Rim scored factors which affected their trip. However, the analysis of variance showed that forest scenery was very important to visitors to the North Rim, second only to the canyon views. Most visitors felt that the forest scenery added a lot to their enjoyment of the trip. This indicates that significant changes in the forest scenery might affect visitor enjoyment and recreation value at the North Rim.

An important underlying assumption in scenic beauty research is that the expressed preferences of respondents are related to landscape attractiveness and that the greater the preference, the higher the attractiveness (Daniel and Boster, 1976). Visitors consistently identified the photo card showing the greatest amount of defoliation as their least attractive forest condition card. A quarter of the respondents placed the cards in

order from least to most defoliated and indicated that this was their preferred order in terms of decreasing attractiveness. However, there was considerable disagreement among the respondents concerning the three cards with less defoliation represented.

This seems to indicate that visitors do not begin to notice defoliation until it becomes relatively intense and that, up to that point, defoliation is not an important factor in the identification of attractive areas. However, previous research had indicated that viewers evaluate stands as a dichotomy, either damaged or undamaged, and that viewers notice defoliation as soon as it becomes visible (Buhyoff and Leuschner, 1978). This apparent contradiction may be due to several factors. Buhyoff and Leuschners' (1978) research was done with western spruce budworm, which causes a short-term but highly visible color change. Pandora moth defoliation does not cause a color change, and therefore may be less apparent to viewers. Also, the variety and heterogeneity natural in ponderosa pine stands may keep viewers from identifying defoliation until the stand has been heavily thinned.

Previous research has also found that uninformed viewers tend to prefer some degree of damage (Buhyoff et al., 1979; Buhyoff et al., 1982). The results of this study show that viewers consistently ranked the photo card depicting the heaviest defoliation lowest in attractiveness, but did not place the other cards in any consistent order. Perhaps some of the respondents

actually preferred those photo cards which depicted some defoliation. Brown and Daniel (1984) found that the openess and variety of stands affect perceptions of scenic beauty, and low to moderate defoliation may enhance those attributes.

Interpretation did not affect respondents' ordering of cards by attractiveness. Similar results were found by Taylor and Daniel (1984) who reported that information did not change the visitor's perception of what was attractive and what was unattractive. Perception, as opposed to attitude, apparently cannot be changed by education or interpretation. Other research has found that informed viewers tend to evaluate damaged scenes more negatively than uninformed viewers (Buhyof and Leuschner, 1978; Buhyoff et al., 1979; Buhyoff et al. 1982). Again, that research was done on stands which were damaged by western spruce budworm or southern pine beetle, which cause coloration changes in the affected trees' foliage.

Most visitors could not recall the most defoliated part of the forest, around the Walhalla Overlook, and if they could, they did not identify it with the most defoliated photo card. Since the outbreak affected only a small segment of the forest road corridor, visitors passed through a large amount of undamaged forest on the way to Cape Royal, and were not affected by the small area of defoliation. Although forest scenery is important to most visitors to the North Rim, small sections of damage apparently do not capture the attention or detract from the visitor's experience.

Most visitors would pay the same amount for their trip to the North Rim under all of the levels of forest defoliation represented by the photo cards. Thus, although forest scenery contributed a great deal to the enjoyment of the trip, the canyon was apparently more important, and the trip was worthwhile even though the forest was defoliated in varying degrees. As defoliation becomes severe, however, visitors' recreational value declines.

Interpretation increased visitor knowledge about what caused the loss of needles in the most defoliated photo set. Those that received interpretation were much more knowledgeable about the cause of the loss than those who did not receive interpretation. Furthermore, interpretation affected reactions to the six policy questions presented to the respondents. Those who received interpretation agreed significantly more strongly with Park Service policy, except in the case of long-term change around the cabins and lodge.

The above findings have several implications for recreation managers. First, if pandora moth damage is not severe or occurs in a limited area, visitors are apt not to notice if they are driving through the area, and recreation value will not be affected. In these situations, interpretive effort and expense would not be likely to improve the quality of the experience.

If the damage is more apparent to the visitor, interpretation will not affect the visitor's ranking of the attractiveness of the area. However, interpretation will increase

visitor knowledge significantly, and will affect agreement with policies. These results indicate that visitors who receive interpretation agree more strongly with policies that allow natural occurrences to run their course, especially if the damage will be short-term, or occurs in backcountry areas that are not heavily used.

However, visitors in general do not agree with policies that allow long-term damage to occur in camping and lodging areas, or areas of heavy visitor use. This indicates that different management policies may be appropriate for different areas of the park or recreation area, as well as for different levels and durations of change.

Further research should begin to delineate the limits to the use of interpretation as a means of affecting public perceptions, attitudes, and understanding. Recreation managers may eventually apply interpretive methods to many situations where methods of control of natural occurrences may be too expensive or time consuming. Agencies to whom public support is important may look to interpretation as an important tool.

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IT IS THE POLICY OF THE NATIONAL PARK SERVICE TO ALLOW NATURAL PROCESSES TO RUN THEIR COURSE.

a. This is a good policy for Grand Canyon National Park.

b. This is a good policy for all national parks.

c. This is a good policy when the change to the forest is only short-term and most trees will recover within one to two years.

d. This is a good policy even when the change to the forest is long-term, large numbers of trees will not recover, and new growth may take in execess of ten years to become established.

e. This is a good policy when the change to the forest is the same as in part d, but occurs in undeveloped or backcountry areas of the park.

f. This is a good policy when the change to the forest is the same as in part d, but occurs in and around the lodge, cabins, and campground.

STRONGLY AGREE	AGREE	NO OPINION	DISAGREE	STRONGLY DISAGREE

Figure 2: Representation of a Card Handed to Respondents, Containing Six Statements About Park Service Policy.

Table 1: Summary of Travel and Demographic Information.

	Average	Percent
Travelling on own		99.4%(721)
On tour		.6%(4)
Going to South Rim		25.5%(185)
Going other places		93.0%(675)
Number of trips		
to Grand Canyon	3.3	
to North Rim	1.9	
People		
in vehicle	2.9	
in household	2.3	
Length of stay	2.4 days	
States (top five in visitation)		
Arizona		10.0%
California		16.5%
Utah		5.0%
Texas		4.3%
New York		4.3%
Countries (top five in visitation)		
Canada		2.2%
West Germany		2.6%
England		.8%
Switzerland		.8%
Denmark		.8%
Age		
17-25		9.5%
26-35		20.0%
36-45		28.0%
46-55		19.8%
56-65		14.2%
66-75		7.7%
76-85		.8%
Income		
Under $5000		2.8%
$5000-9999		2.7%
$10000-14999		5.4%
$15000-19999		5.5%
$20000-24999		7.4%
$25000-29999		8.4%
$30000-34999		10.2%
$35000-44999		13.7%
$45000-49999		10.6%
$50000-74999		20.0%
$75000-99999		7.2%
$100,000 or more		6.1%

Table 2: Sigificance of Interpretation in Affecting the Response to Each Factor Affecting the Quality of the Trip, Tested with Chi-Square Analysis (a) (b)

	Contribution to Quality of Trip					
Factor	Added A Lot	Added	Neither	Subtr.	Subtr. A Lot	Signif-icance
Canyon Views						.0783
Interp.	90.2%	7.3%	2.0%	.4%	0	
No interp.	91.3%	7.9%	.2%	.6%	0	
Forest Scenery						.1393
Interp.	78.4%	20.0%	1.6%	0	0	
No interp.	72.9%	22.3%	4.6%	.2%	0	
Facilities						.2187
Interp.	26.1%	38.4%	20.8%	12.7%	2.0%	
No Interp.	25.4%	40.0%	21.5%	8.5%	4.6%	
Temperature/Climate						.3717
Interp.	55.9%	26.9%	14.7%	2.4%	0	
No Interp.	49.6%	31.7%	15.0%	3.1%	.6%	
Number of Visitors						.8501
Interp.	21.6%	26.5%	42.0%	7.8%	2.0%	
No Interp.	22.7%	24.6%	42.3%	7.1%	3.3%	
Nature Study/Interpretive Programs (c)						.0440
Interp.	26.1%	26.9%	10.6%	0	0	
No Interp.	17.9%	26.0%	14.6%	1.3%	.2%	
Cleanliness and Maintenance of the Area						.2322
Interp.	53.1%	40.4%	6.1%	.4%	0	
No Interp.	58.8%	32.9%	6.9%	.8%	.6%	

(a) 246 respondents received interpretation, 480 did not
(b) Percents do not add to 100% due to rounding
(c) 36% of interpretation and 40% of no interpretation respondents answered "not applicable".

Table 3: Analysis of Variance and Student-Neuman-Keuls Test Results on Factors Affecting the Visit.

ANOVA

Source	Sum of Squares	Degrees Freedom	Mean Square	F	Signif-icance
1) Mean	13049.83043	1	13049.83043	8023.27	.0000
Interp	.61440	1	.61440	.38	.5391
Error	796.98374	490	1.62650		
2) Factors	1917.74274	6	319.62379	294.69	.0000
Interact.	8.07259	6	1.34543	1.24	.2822
Error	3188.75610	2940	1.08461		

Student-Neuman-Keuls

Mean	Group	1	2	7	4	6	3	5
1.0976	1 (canyon views)							
1.2602	2 (forest scenery)	*						
1.5041	7 (cleanliness)	*	*					
1.6911	4 (other visitors)	*	*	*				
2.2622	6 (nature study)	*	*	*	*			
2.4045	3 (climate)	*	*	*	*	*		
3.4085	5 (facilities)	*	*	*	*	*	*	

* denotes significant difference (.05 level)

Table 4: Summary of Visitors' Average Cost

Expense	Mean	S.D.	Median
Transportation	$58.00	$126.08	$25.00
Entry fee			$5.00
Food, beverages, incidentals	$51.35	$62.77	
Lodging at North Rim	$39.62	$60.04	
Total Cost	$154.94	$203.83	

Table 5: Percentage of Respondents Placing Each of the Photo Cards in Each Position According to Attractiveness.

	Position According to Attractiveness				
	Least Favorite	Sec. least Favorite	Sec. most Favorite	Most Favorite	Total
Pre defol.	1.2%	30.9%	30.7%	37.3%	100.1%(a)
Second least defol.	.7%	13.6%	40.2%	45.4%	99.9%(a)
Second most defol.	2.5%	53.4%	27.9%	16.2%	100%
Most defol.	95.6%	2.1%	1.2%	1.1%	100%
Total	100%	100%	100%	100%	

(a) Percents do not add to 100% due to rounding

Table 6: Significance of Interpretation in Ranking of Photo Cards According to Attractiveness, Tested with Chi-Square Analysis (a) (b)

	Defoliation Level				
Card	Heavy Defol.	Moderate Defol.	Low Defol.	No Defol.	Signif-icance
Most Attractive					.8199
Interp.	.9%	16.7%	47.5%	34.8%	
No interp.	1.2%	16.0%	44.6%	38.2%	
Second Most Attractive					.5212
Interp.	.5%	28.5%	38.5%	32.6%	
No interp.	1.6%	27.7%	40.9%	29.9%	
Second Least Attractive					.5286
Interp.	.9%	53.4%	14.0%	31.7%	
No interp.	2.6%	53.3%	13.4%	30.7%	
Least Attractive					.2268
Interp.	97.7%	1.4%	0	.9%	
No interp.	94.6%	3.0%	1.0%	1.4%	

(a) 246 respondents received interpretation, 480 did not
(b) Percents do not add to 100% due to rounding

Table 7: Significance of Interpretation in Affecting the Responses to What Caused the Defoliation, Tested with Chi-Square Analysis (a)

Response	Interpretation	No Interpretation
Insects	36.2%	18.6%
Pandora Moth	48.1%	3.9%
Fire	7.6%	25.9%
Disease	1.9%	13.0%
Pollution	1.9%	14.7%
Acid Rain	24.0%	7.3%
Drought	1.4%	12.5%
Don't Know	.5%	4.2%

Chi-square	Degrees Freedom	Significance
256.55442	7	.0000

(a) 246 respondents received interpretation, 480 did not

Table 8: Significance of Interpretation in Affecting Responses to each Policy Question, Tested with Chi-Square Analysis (a) (b)

	Strength of Agreement					
Policy	Strongly Agree	Agree	No Opinion	Disagr.	Strongly Disagr.	Signif-icance
Grand Canyon						.0000
Interp.	46.2%	43.4%	3.2%	5.4%	1.8%	
No interp.	26.2%	55.0%	3.4%	14.1%	1.4%	
All Parks						.0000
Interp.	38.9%	38.0%	5.9%	15.8%	1.4%	
No interp.	21.0%	51.8%	4.2%	21.0%	2.0%	
Short term						.0002
Interp.	48.9%	44.8%	2.3%	3.6%	.5%	
No interp.	31.7%	61.9%	1.4%	3.8%	1.2%	
Long term						.2686
Interp.	16.3%	40.3%	6.8%	31.7%	5.0%	
No interp.	11.9%	36.3%	8.9%	37.3%	5.6%	
Backcountry						.0465
Interp.	24.4%	46.6%	6.3%	19.0%	3.6%	
No interp.	16.0%	48.5%	6.6%	26.1%	2.8%	
Cabins						.0465
Interp.	12.2%	28.5%	8.1%	42.1%	9.0%	
No interp.	7.0%	26.4%	6.0%	52.1%	8.5%	

(a) 246 respondents received interpretation, 480 did not
(b) Percents do not add to 100% due to rounding

Table 9: Analysis of variance and Student-Neuman-Keuls Test on Policy Questions and Whether or Not Interpretation was Received.

ANOVA

Source	Sums of Squares	Degrees Freedom	Mean Squares	F	Signif-icance
1) Mean	16765.32012	1	16765.3201	4521.05	.0000
Interp	51.78896	1	51.7889	13.97	.0002
Error	1817.05759	490	3.7083		
2) Policy	746.55589	5	149.3112	232.94	.0000
Interact.	1.88381	5	.3768	.59	.7094

Student-Neuman-Keuls

Mean	Group	3	1	2	5	4	6
1.7515	3 (short-term)						
1.9226	1 (Grand Canyon)	*					
2.1833	2 (NPS)	*	*				
2.4265	5 (backcountry)	*	*	*			
2.7882	4 (long-term)	*	*	*	*		
3.2200	6 (cabins)	*	*	*	*	*	

* denotes significant difference (.05% level)